

Package Boiler Simulator with Low NO_x Precombustor

1. Capabilities

The precombustion chamber burner utilizes staged combustion technology capable of achieving NO_x emissions of less than 0.1 lb (as NO₂)/10⁶ BTU (approximately 90 ppm NO_x), even with high nitrogen content fuels. The pilot-scale experimental facility consists of a vertical low NO_x precombustion chamber burner and a horizontal watertube package boiler simulator. A conventional high-swirl burner with primary air and fuel injection systems provides substoichiometric primary air and fuel/waste to the precombustion chamber. The chamber itself is of modular design allowing variation in nominal first-stage residence time between 250 and 750 ms. A water-cooled transition section (10 in. inside diameter) cools the combustion gas before secondary air addition to minimize thermal NO_x generation. The burner transition section allows for radial addition of staged air. Additionally, the boiler's front face has two ports for addition of staged (reburning) fuel at an angle of 45 degrees off axis and six axial ports for the addition of axial reburn air. This design allows for reburning application from the boiler front face with aerodynamic separation of the fuel-lean, fuel-rich, and fuel-lean zones in the boiler.

2. Size

Burner firing rate: 3,000,000 BTU/hr
Precombustion chamber inside diameter: 20 in.
Precombustion chamber length: variable (65 in. to 108 in.)
Package boiler simulator inside diameter: 23 in.
Package boiler simulator length: 140 in.

3. Test Requirements

Testing requires an approved Quality Assurance Project Plan (QAPP) and a Health and Safety Protocol. Testing also requires the operation of the Wing-G Flue Gas Cleaning System (FGCS). It takes one technician to operate the FGCS, plus one engineer and one technician to operate the unit during tests. Any additional extractive sampling procedures (MM5, VOST, multi-metals train) require additional sampling technicians.

4. Raw Materials Required

Raw materials generally consist of necessary fuel and waste streams to achieve desired properties.

5. Data Produced Per Run

Data consists of strip charts with CEM data, plus tab-delimited ASCII files of the CEM (O₂, CO, CO₂, THC, NO_x) and thermocouple data.

6. Length of Run

Sufficient time, usually one to two days, must be allowed for the system to approach thermal equilibrium after operating conditions are altered. Typically, only one experimental situation can be examined during any one eight-hour shift. The combustor is equipped with a flame safety system to allow unattended operation so as to maintain temperatures at night and over weekends. If extractive sampling for detailed organic analysis is to be performed, approximately one-half day of set up and one-half day of equipment take-down time must be added.

7. Cost per Run (per day)

Operating costs of approximately \$1200/day include the loaded fees of a Lead Engineer, a Unit Technician, an FGCS Technician, and other maintenance and expendable materials. Other services provided by a Sampling Technician (for non-routine chemical analysis) or materials for other analytical work are not included in this estimate.

8. Contact Person

William Linak, Ph.D.
U.S. EPA
Air Pollution Prevention and Control Division
Air Pollution Technology Branch (MD-65)
Research Triangle Park, NC 27711
919/541-5792
linak.bill@epa.gov